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# मानक

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IS 11298-3-2 (1990): Plastic films for electrical purposes, Part 3: Specifications for individual materials, Section 2: Metallized polypropylene films [ETD 2: Solid Electrical Insulating Materials and Insulation Systems]



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“Knowledge is such a treasure which cannot be stolen”



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*Indian Standard*

**PLASTIC FILMS FOR ELECTRICAL  
PURPOSES — SPECIFICATION**

**PART 3 SPECIFICATIONS FOR INDIVIDUAL MATERIALS**

**Section 2 Metallized Polypropylene Films**

**भारतीय मानक**

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**BUREAU OF INDIAN STANDARDS**  
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NEW DELHI 110002

## **Solid Electrical Insulating Materials Sectional Committee, ETD 2**

### **FOREWORD**

This Indian Standard ( Part 3/Sec 2 ) was adopted by the Bureau of Indian Standards on 23 February 1990, after the draft finalized by the Solid Electrical Insulating Materials Sectional Committee had been approved by the Electrotechnical Division Council.

This standard ( Part 3/Sec 2 ) is one of the series of Indian Standards which deals with plastic films for electrical purposes. The series will have the following three parts:

Part 1 Definitions and general requirements,

Part 2 Methods of test, and

Part 3 Specifications for individual materials.

This standard ( Part 3/Sec 2 ) covers the requirements for metallized polypropylene films.

Requirements of polypropylene films for capacitors are covered by IS 11298 ( Part 3/Sec 1 ) : 1987 'Plastic films for electrical purposes: Part 3 Specification for individual materials, Section 1 Polypropylene films for capacitors.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values ( *revised* ).' The number of significant places retained in the rounded off value should be same as that of the specified values in this standard.

**AMENDMENT NO. 1 APRIL 1993**  
**TO**  
**IS 11298 ( Part 3/Sec 2 ):1990 PLASTIC FILMS FOR**  
**ELECTRICAL PURPOSES — SPECIFICATION**  
**PART 3 SPECIFICATION FOR INDIVIDUAL MATERIALS**  
**Section 2 Metallized Polypropylene Films**  
*( Page 1, clause 1.1, Note ) — Delete.*

( ET 02 )

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*Reprography Unit, BIS, New Delhi, India*

*Indian Standard***PLASTIC FILMS FOR ELECTRICAL PURPOSES — SPECIFICATION****PART 3 SPECIFICATIONS FOR INDIVIDUAL MATERIALS****Section 2 Metallized Polypropylene Films****1 SCOPE**

**1.1** This standard ( Part 3/Sec 2 ) covers the requirements of metallized polypropylene films with suitable surface treatment like corona treatment for metallization with the base film.

NOTE — Specification for base films is under preparation.

**2 REFERENCES**

**2.1** The following Indian Standards are necessary adjuncts to this standard.

<i>IS No.</i>	<i>Title</i>
11298 ( Part 1 ) : 1985	Plastic films for electrical purposes : Part 1 Definitions and general requirements
11298 ( Part 2 ) : 1987	Plastic films for electrical purposes : Part 2 Methods of test
11298 ( Part 3/Sec 1 ) : 1986	Plastic films for electrical purposes: Part 3 Specifications for individual materials, Section 1 Polypropylene films for capacitors

**3 TERMINOLOGY**

**3.1** For the purpose of this standard, the following definitions in addition to those given in IS 11298 ( Part 1 ) : 1985, shall apply.

**3.2 Tram Lines**

These are semi-metallized lines appearing on the surface of the film.

**3.3 Natural Pairs**

Pairs of two rolls having margins on the opposite sides.

**3.4 Reel Wobble**

Eccentric movement of roll in machine direction.

**3.5 Reel Dishing**

This is gap between outer rim of the reel and flat packing plate.

**3.6 Reeling Tolerance**

Protrusion or feathering of the layers from the end face of the reel throughout the winding.

**3.7 High Reel Edges**

This is the lateral displacement of edges of layers.

**3.8 Gloss**

The attribute of the property for regular reflection of light from object surfaces. The quantity of light of regular reflection and the visibility of the regular reflection image are included in the regular reflection property.

**3.9 Coefficient of Friction**

It is the ratio of the frictional forces ( the resisting force that arises when a surface of one substance slides or tends to slide, over an adjoining surface of itself ). This is the measure of relative difficulty with which the surface of one material will slide over an adjoining surface of itself.

**3.10 Average Roughness ( Ra )**

This is the mean value of peaks and valleys over the mean line of profile or roughness curve.

**3.11 Maximum Roughness ( Rm )**

The maximum height, when a sampled portion has been interposed between the two parallel straight lines with a mean line of which length corresponds to the reference length that has been sampled from the profile.

**3.12 Lot**

In a consignment all the slit rolls of the same thickness and type manufactured from the same material under similar conditions of production shall be grouped together to constitute a lot.

**4 GENERAL REQUIREMENTS**

**4.1** All materials in a consignment shall comply with the requirements given in IS 11298 ( Part 1 ) : 1985.

**4.2** Metallization shall be carried out employing metal of high purity. The metallization shall be continuous and free from unmetallized spots.

**4.2.1** Isolated scratches shall not exceed 5 mm and the gap between the two scratches shall not be less than 15 mm.

**4.2.2 Unmetallized Margin**

Preferred standard widths of unmetallized margins shall be:

For aluminium —  $2.5 \pm 0.5$  mm.

For zinc — 1.5, 2.0, 2.5, 3.0, 4.5 mm  
with tolerance of  $\pm 0.5$  mm.

**4.3 Special Requirements**

In order to obtain a good metal adhesion for vacuum metallization and its surface finish, the base film shall have proper  $R_a$  (Average roughness) and  $R_m$  (Maximum roughness). The surface roughness over finish can be measured by arithmetic mean roughness ( $R_a$ ). Recommended value of  $R_a$  is 0.11.

**5 PERFORMANCE REQUIREMENTS**

**5.1** When tested according to the relevant methods described in IS 11298 ( Part 2 ) : 1987 the material shall conform to the requirements given in Table 1 and 5.2 to 5.10.

**5.2 Resistance Metal Layer**

The standard coating thickness of metallized polypropylene film shall measure as follows:

For aluminium — 3 ohm/sq  $\pm 1.0$  ohm, that is, range of 2 to 4 ohm/sq units.

For zinc — 7.5 ohm/sq  $\pm 1.5$  ohm and 1.5 ohm to 3.1 ohm in reinforced area ( in case of heavy edge films ).

For zinc-aluminium alloy — 3.0 ohm/sq  $\pm 1.0$  ohm. The cross direction resistivity ( average of 6 individual values ) shall be as follows:

For aluminium : 2.7 ohms to 3.3 ohms.

For zinc : 6.75 ohm to 8.25 ohm.

NOTE — Other values may be agreed to between the purchaser and the supplier.

**5.3 Coating Adhesion**

An adhesion tape applied on the metallized coating with finger tip pressure shall not remove metal when peeled off at an angle of 45° max.

**5.4 Tram Lines**

Thus visual effect is acceptable provided the measured electrode resistance across the tram lines does not differ from the surroundings electrode resistance by more than 0.5 ohm/sq.

**5.5 Tightness of Winding**

The reels shall be wound compactly so that they will not telescope under film tension and speeds used in winding capacitor elements.

The reel shall be wound so tight that core should not be pushed out if weight in kg calculated as below is applied.

Calculated weight in kg —  $0.15 \times \text{film width in mm}$ .

**5.6 Film Clearing**

If agreed between the manufacturer and the user, a dc voltage of 50 V/micron up to a maximum of 500 V dc shall be applied to clear any weak points in the film.

**5.7 Electrostatic Charge**

The electrostatic of the film shall be minimum. To determine the charge the film shall be

**Table 1 Property-wise Requirements for the Metallized Polypropylene Films**  
( Clause 5.1 )

Sl No.	Property	Test Method of Clause Ref IS 11298 ( Part 2 ) : 1987	Requirement	Tolerance	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
1.	Thickness	4	Preferred thickness 6, 8, 9, 10 and 12 mm	$\pm 6$ percent	—
2.	Width (mm)	9	Preferred widths 37.5 mm, 50 mm, 75 mm, 100 mm	$\pm 0.1$ mm	—
3.	Length/diameter	—	Preferred standard lengths of rolls are not given because of the widely different and developing requirements throughout the industry.	—	The length and width of the film is subject to agreement between the buyer and the seller
4.	Shrinkage	—	Along machine direction Along Cross machine direction	— 4 percent — 2 percent	The maximum permissible shrinkage of the polypropylene film when conditioned for 10 minutes in a circular hot air oven maintained at 100°C shall be as indicated in col 4,



unwound. Some layers of the film shall be cut off and discarded. The reel shall be held in a vertical position, two turns shall be unwound. The reel shall then be held horizontally 1.5 metres length of the film shall be allowed to hang freely from the roll. Under these conditions the roll shall unwind itself freely.

### 5.8 Voltage Proof Test

This shall be determined in accordance with Annex A.

### 5.9 Power Factor

**5.9.1** The power factor of dry film shall be  $2 \times 10^{-4}$  ( Max ).

**5.9.2** The power factor of the capacitors shall be  $3 \times 10^{-4}$  or better.

### 5.10 Sampling Plan

**5.10.1** Sampling plan for the hazy and plain polypropylene films from slit rolls shall be as given in Annex B.

#### 5.10.2 Criteria for Conformity

The number of rolls selected in the sample as per column 1 and 2 of Annex B shall be subjected to all the acceptance tests. A roll failing to meet the requirements of any of the acceptance tests shall be termed as defective. The lot shall be considered as conforming to the requirements of acceptance tests, if the number of defectives in the sample is less than or equal to the corresponding permissible number of defectives given in the last column of Annex B; otherwise not.

## 6 PACKING AND MARKING

### 6.1 Natural Pairs

All reels to be manufactured and packed in natural pairs that is, taken from either side of a common margin band after slitting. Thus any increase in margin width within the tolerance of one reels of the pair is accompanied by a decrease in the margin width of the paired reel. This greatly assists in keeping intact the active electrode area and hence the capacitance. This will also ensure equal metallized surface on the lower side of the film. In this position, the reel with the margin on its right hand side to be marked with red sticker whilst the reel with its margin on the left hand side to be marked with green sticker.

### 6.2 Bobbins

Preferred core inside diameter will be 75 mm  $\pm 0.8$  mm. Other diameters may be agreed between the manufacturer and the user. Preferred outside diameter of reels shall range between 165 mm to 240 mm as agreed between the manufacturer and the user.

Core wall thickness to be adequate depending on the reel diameter. Width of the core should be nominal film width  $\pm 0.5$  mm.

Cores may protrude by up to 0.3 mm from either side of the reel.

Core material shall be preferably moulded/reinforced plastic/fibre or metallic.

### 6.3 Reel Wobble

The maximum reel wobble measured with a gauge at the outside diameter of the reel when clamped against a flat plate shall not exceed 0.3 mm.

### 6.4 Reel Saucering or Dishing

The maximum saucering or dishing of the reel ( the gap between the outer rim of the reel and a flat packing plate ) when measured with a gauge shall be 0.3 mm.

### 6.5 Reeling Tolerance

Reels may have layers protruding from the end face of the reel throughout the winding provided the protrusion or feathering does not exceed 0.3 mm. The overall width of the reel is measured with vernier caliper and should not be higher than the measured film width by more than 0.3 mm.

### 6.6 High Reel Edges

Any high edges on the reel shall not be more than 0.3 mm higher than the flat centre part of the reel.

### 6.7 Reel Joints

Up to max 3 joints will be permitted in a reel having outside diameter between 165 mm to 240 mm.

Joints to be made with readily visible coloured adhesive polyester tape.

### 6.8 Packing

The reels shall be sealed in suitable plastic film in a natural pairs.

### 6.9 Marking

**6.9.1** Each reel shall be identified by a label with the following information:

- a) Nominal thickness in width,
- b) Type and number of the film,
- c) Date of metallization,
- d) Indication of source of manufacture,
- e) Width and margin,
- f) Right hand margin/left hand margin,
- g) Resistance, and
- h) Batch number.

**ANNEX A**  
( Clause 5.8 )

**VOLTAGE PROOF TEST**

**A-1** For each roll pieces, three pieces of 50 cm length and at 5 m intervals shall be cut.

**A-2** Samples shall be subjected to voltage-proof test and the voltage mentioned in the following table:

<i>Voltage Proof</i>	
Thickness Microns ( Nominal )	Voltage V dc
6	900
8	1 200
9	1 350
10	1 500

**A-3** Voltage proof test shall be conducted for a period of one minute.

**A-4** The breakdown voltage for the base film and the metallized polypropylene film shall not be less than 200 volts/micron.

**A-5** All the three pieces of each roll shall pass the test.

**ANNEX B**  
( Clause 5.10.1 )

**SAMPLING PLAN FOR METALLIZED HAZY AND PLAIN POLYPROPYLENE FILMS  
FROM SLIT ROLLS**

(Applicable for slit rolls only and not for mill rolls )

Lot Size ( No. of Rolls )	Sample Size to be Drawn for Tests ( No. of Rolls )	Permissible No. of Defectives
Up to 50	5	0
From 51 to 100	8	0
From 101 to 300	13	1
From 301 to 500	20	1
From 501 to 1 000	32	2
From 1 001 and above	50	3

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